B1 Contd

motor may not develop sufficient torque to restart disk spinning. This may lead to failure of the disk drive.--

Please replace the paragraph beginning on page 4, line 7 with the following rewritten paragraph:

B2

--As mentioned above, PFPEs have been used extensively to form a lubricant film in a magnetic recording medium. PFPEs are relatively expensive. Therefore, cheaper alternatives are more desirable. Although PFPEs have good thermal stability, they decompose readily when they are in contact with Lewis acids. This is an important consideration because the head often is fabricated from an Al_2O_3/TiC composite, and Al_2O_3 can be converted to AlF_3, a strong Lewis acid. This formation of AlF_3 leads to chemical degradation of PFPE lubricants. Moreover, use of chlorofluorohydrocarbons ("CFCs") as solvent generally is involved when PFPEs are applied to a magnetic medium. CFCs have detrimental effects on the ozone layer, and use thereof should be avoided, if possible.--

Please replace the paragraph beginning on page 7, line 14 with the following rewritten paragraph:

B3

--Since a lubricating film on a magnetic recording medium is exposed to atmospheric conditions and is applied only once during the manufacturing process, the lubricant in the form of a film over a magnetic recording medium preferably should have low vapor pressure, high chemical stability, good load-carrying capability, and desirable tribological properties. Substituted cyclopentanes, cyclopentenes, and cyclopentadienes possess the requisite properties for use as a lubricant film or layer in a magnetic recording medium. Some embodiments utilize oligomeric cyclopentane, cyclopentene, and cyclopentadiene derivatives prepared by reacting cyclopentadienes or alkyl-substituted cyclopentadienes with polyhydric alcohols followed by hydrogenation, if appropriate.--

Please replace the paragraph beginning on page 7, line 24 with the following rewritten paragraph:

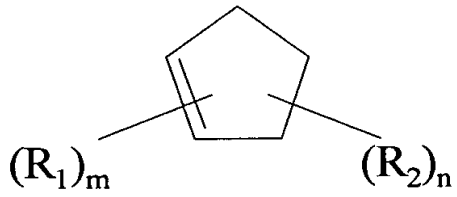
B4

--As mentioned above, suitable compounds for forming a lubricant layer or film over a layer of magnetic material include hydrocarbyl-substituted cyclopentanes, hydrocarbyl-substituted cyclopentenes, hydrocarbyl-substituted cyclopentadienes, and mixtures or derivatives thereof. These compounds are selected because they have low vapor pressure and desired tribological properties. For example, tris-(2-octyldodecyl) cyclopentane has a vapor pressure of about 1 x 10

$^{-12}$ Torr at about 20°C. Its tribological properties are better or comparable to some of the existing lubricants for magnetic recording media. In addition, it has good thermal stability, additive solubility, and oxidation resistance.--

Please replace the paragraph beginning on page 8, line 14 with the following rewritten paragraph:

--Suitable hydrocarbyl-substituted cyclopentenes generally have the following formula:



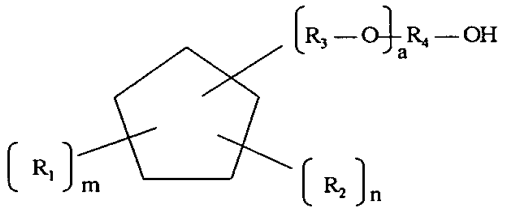
where R_1 and R_2 are hydrocarbyl groups, respectively, m and n are zero or positive integers, respectively. Preferably, the sum of m and n should be less than 6, although compounds with m+n exceeding six are also suitable in embodiments of the invention. It should be understood that the double bond can be located anywhere in the ring. Furthermore, either or both R_1 and R_2 may be further derivatized to include any polar groups.--

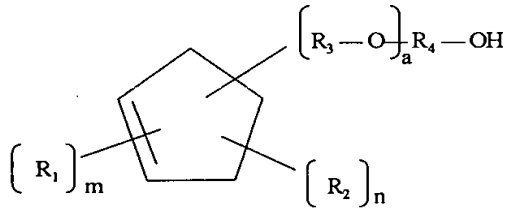
Please replace the paragraph beginning on page 10, line 5 with the following rewritten paragraph:

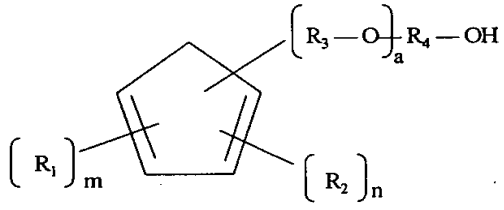
--Preferably, m is 0, 1, 2, or 3, although it may be any other positive integers. Preferably, n is an integer ranging from two to six, although it may be 0 or any other positive integers. Preferably, the sum of m and n should not be greater than six, although compounds with m+n exceeding six are also suitable in embodiments of the invention.--

Please replace the paragraph beginning on page 12, line 10 with the following rewritten paragraph:

--For example, a cyclopentane, cyclopentene, or cyclopentadiene which includes a polyether or a hydroxyl group may be represented by the following formulas:







wherein a is any integer, such as 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10; m and n can be zero or any positive integers. Preferably, the sum of m and n should be less than 5, although compounds with m+n exceeding five are also suitable in embodiments of the invention. R_1, R_2, R_3, and R_4 are individually a hydrocarbyl group, which may or may not include a polar group.--

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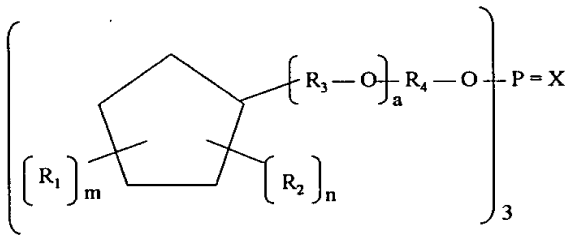
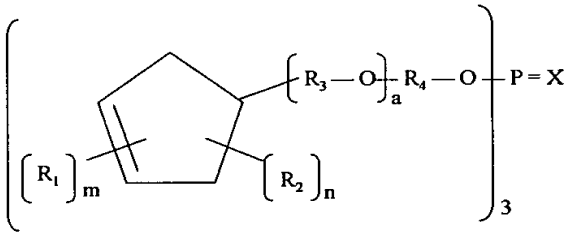
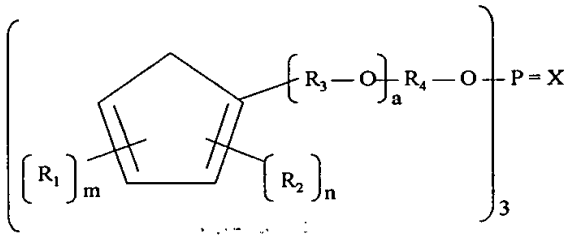
Please replace the paragraph beginning on page 13, line 7 with the following rewritten paragraph:

--A cyclopentane, cyclopentene, or cyclopentadiene which includes a phosphate or thiophosphate group may be represented by the following formulas:







wherein a is any integer, such as 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10; m and n can be zero or any positive integers. Preferably, the sum of m and n should be less than 5, although compounds with m+n exceeding five are also suitable in embodiments of the invention. R_1, R_2, R_3, and R_4 are individually a hydrocarbyl group, which may or may not include a polar group; X is either oxygen or sulfur.--

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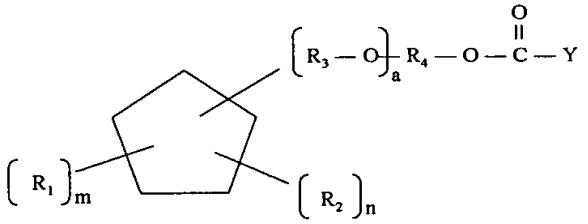
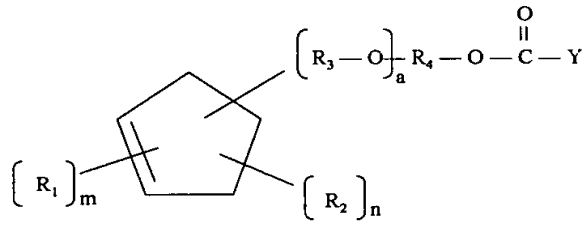
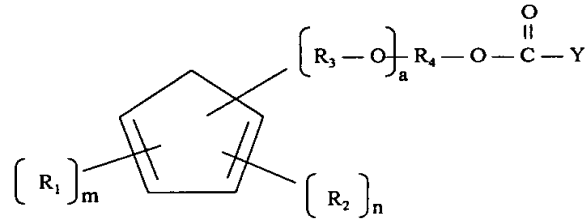
Please replace the paragraph beginning on page 14, line 6 with the following rewritten paragraph:

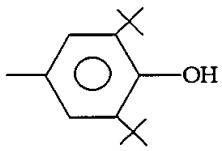
--A cyclopentane, cyclopentene, or cyclopentadiene which includes a carboxylic acid, ester, phenolic ester, or amide group may be represented by the following formulas:







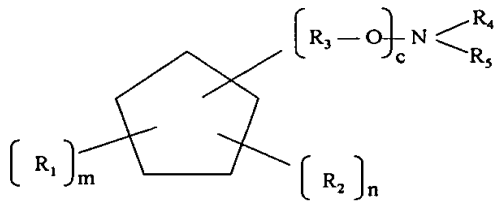
wherein a is any integer, such as 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10; m and n can be zero or any positive integers. Preferably, the sum of m and n should be less than 5, although compounds with m+n exceeding five are also suitable in embodiments of the invention. R_1, R_2, R_3, and R_4 are individually a hydrocarbyl group, which may or may not include a polar group; Y may be

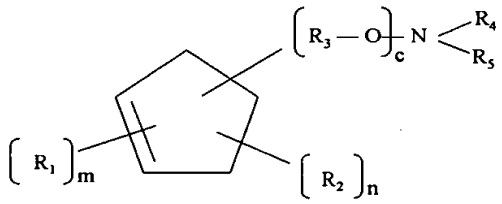


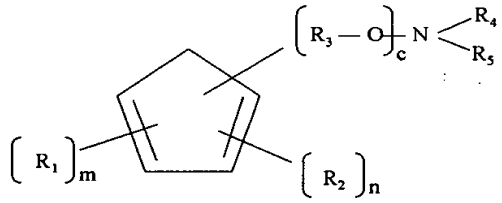
-OH; $-NH_2$; and $-(CF_2)_b-F$ (in which b is 1, 2, 3, ..., or 20).--

Please replace the paragraph beginning on page 15, line 7 with the following rewritten paragraph:

--A cyclopentane, cyclopentene, or cyclopentadiene which includes an amine group may be represented by the following formulas:



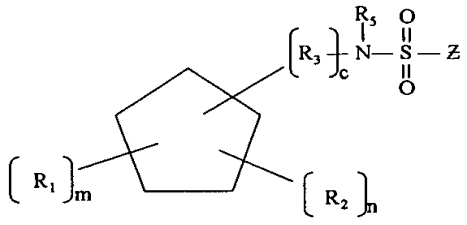


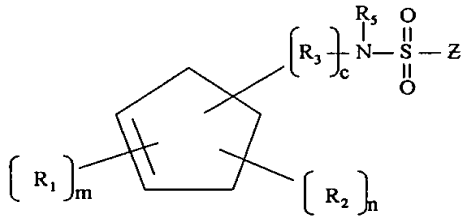


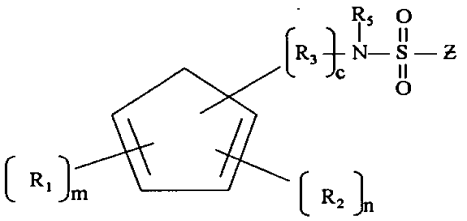
wherein c is any integer, such as 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10; m and n can be zero or any positive integers. Preferably, the sum of m and n should be less than 5, although compounds with m+n exceeding five are also suitable in embodiments of the invention. R_1, R_2, R_3, R_4, and R_5 are individually a hydrocarbyl group, which may or may not include a polar group; R_4 and R_5 may also be hydrogen individually.--

Please replace the paragraph beginning on page 16, line 7 with the following rewritten paragraph:

--A cyclopentane, cyclopentene, or cyclopentadiene which includes a sulfonamide group may be represented by the following formulas:







wherein c is any integer, such as 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10; m and n can be zero or any positive integers. Preferably, the sum of m and n should be less than 5, although compounds with m+n exceeding five are also suitable in embodiments of the invention. R_1, R_2, R_3, and R_5 are individually a hydrocarbyl group, which may or may not include a polar group; R_5 may also be hydrogen; Z may be a hydrocarbyl group or $-(CF_2)_b-F$ (in which b is 1, 2, 3, ..., or 20).--

Please replace the paragraph beginning on page 20, line 13 with the following rewritten paragraph:

--Tris(2-octyldodecyl)cyclopentadiene (18.12 grams, 20 m mol) was placed in a 3-necked round bottom flask equipped with an additional funnel, a gas inlet adapter, and a septum. After flashing with dried N_2 for 2 minutes, 50 ml of dried THF (distilled over K) was added. The solution was cooled in dry ice/acetone bath, followed injected 8.4 M n-butyl lithium in hexane solution (2.40 ml; 20 m mol). The dry ice/acetone bath was removed, and the resulting dark red

solution was stirred at room temperature for 1 hour, followed by cooling in dry ice/acetone bath. 3-Bromopropionitrile (2.70 grams, 20 m mol) in 10 ml dried THF solution was then dropwise added from the additional funnel. After the addition, the reaction solution was stirred at room temperature for another 3 hours. The reaction was slowly quenched with 10 ml water. The organic layer was separated, and the aqueous layer was extracted with 50 ml hexane. The organic layers were combined, dried over $MgSO_4$, filtered, and rota-vaporized to give 19.6 grams of yellow liquid. The crude reaction product was purified by column chromatography on SiO_2 eluting with 5% ethyl acetate/hexane. The unreacted tris(2-octyldodecyl)cyclopentadiene (3.66 grams) was recovered and the title compound (12.83 grams) was isolated. FTIR: 2248 cm^{-1} (C≡N); ^{13}C NMR (4 isomers): 152.5-129.1 ppm (C=C), 120.8-119.6 ppm (4 peaks; C≡N), 59.5 ppm, 56.9 ppm, 51.3 ppm, 41.1 ppm, 39.5-26.4 ppm, 22.7ppm, 14.1ppm.--

B12 cont'd

Please replace the paragraph beginning on page 21, line 23 with the following rewritten paragraph:

--To a stirring solution of 3- propionitrile (8.38 grams; 9.23 m mol) in 20 ml of dried THF was slowly added 1 M lithium alumina hydride in THF solution (9.3 ml) at 0° C. After the addition, the ice bath was removed. The reaction was further stirred at room temperature for 2 hours. The reaction was slowly quenched with 10 ml of water. The reaction mixture solution was extracted with hexane (2X 20 ml). The organic layer was dried over $MgSO_4$, filtered, and rota-vaporized to yield 8.13 grams, which were further purified by column chromatography on SiO_2 eluting with 40% ethyl acetate/hexane to yield 5.21 grams of the title compound. FTIR: 3392 cm^{-1}, 1618 cm^{-1}, 1074 cm^{-1}, 786 cm^{-1}, and 721 cm^{-1} (no C≡N at 2248 cm^{-1} was present). ^1H NMR: δ 2.66 (2H); δ 1.28; and δ 0.90 (t, 18H).--

B13

Please replace the paragraph beginning on page 22, line 13 with the following rewritten paragraph:

--Tris(2-octyldodecyl)cyclopentadiene (18.12 grams, 20 m mol) was placed in a 3-necked round bottom flask equipped with an additional funnel, a gas inlet adapter, and a septum. After flashing with dried N_2 for 2 minutes, 50 ml of dried THF was added. The solution was cooled in a dry ice/acetone bath, followed by injecting 8.4 M n-butyl lithium in hexane solution (2.40 ml; 20 m mol). The dry ice/acetone bath was removed, and the resulting dark red solution was stirred

B14

at room temperature for 1 hour, followed by cooling in a dry ice/acetone bath. The above tetrahydropyranyl derivative of 2-(2-chchloethoxy)ethanol (4.45 grams, 20 m mol) in 10 ml dried THF was then dropwise added from the additional funnel. After the addition, the reaction solution was stirred overnight at room temperature under N_2. The reaction was slowly quenched with 20 ml water. The organic layer was separated, and the aqueous layer was extracted with 50 ml hexane. The organic layers were combined, dried over $MgSO_4$, filtered, and rota-vaporized to give 21.65 grams of liquid. To the liquid was added 20 ml of methylene dichloride and 0.2 ml of concentrated HCl to de-protect the hydroxy group. The reaction mixture was stirred overnight, followed by aqueous work-up to give 19.27 grams of a crude product. The title compound (16.90 grams) was obtained after purification by column chromatography on SiO_2, eluting with 5% ethyl acetate/hexane. FTIR: 3471 cm^{-1}, 3050 cm^{-1}, 1647 cm^{-1}, 1618 cm^{-1}, 1058 cm^{-1}. ^{13}C NMR (2 isomers): 150.7 ppm, 148.4 ppm, 145.1 ppm, 142.6 ppm, 139.3 ppm, 126.7 ppm, 122.9 ppm, 121.9 ppm, 71.8 ppm, 68.8 ppm, 61.9 ppm, 47.8-26.5 ppm, 22.7 ppm, and 14.1 ppm.--

Please replace the paragraph beginning on page 23, line 9 with the following rewritten paragraph

--The hydrogenation of 2-[2-tris(2-octyldodecyl)cyclopentadienyl]-ethoxy ethanol was carried out in a similar manner as described in Example 2, except the catalyst used was rhodium on alumina.--

Please replace the paragraph beginning on page 23, line 12 with the following rewritten paragraph:

--2-[2-tris(2-octyldodecyl)cyclopentadienyl]-ethoxy ethanol (20 grams), rhodium (5% Rh) on alumina (1 gram), and 250 ml of heptane were placed in a 500 ml Zipper Clave reactor. The hydrogenation was maintained at 950 psi H_2 and 280° C for 24 hours. The title compound was further purified by column chromatography on SiO_2, eluting with 5% ethyl acetate/hexane, to give 18.59 gram of colorless liquid. FTIR: 3471 cm^{-1}, 1120 cm^{-1}, 1058 cm^{-1}, 890 cm^{-1}, 721 cm^{-1}. ^1H NMR: d 3.70 (1H), d 3.52 (1H), d 3.46 (1H), d 1.25, d 0.87. ^{13}C NMR: 71.8 ppm, 70.5 ppm, 61.9 ppm, 52.8-33.7 ppm, 31.9 ppm, 30.3 ppm, 29.8 ppm, 29.5 ppm, 26.7 ppm, 22.7 ppm, and 14.1 ppm.--

Please replace the paragraph beginning on page 23, line 22 with the following rewritten paragraph:

--2-[2-tris(2-octyldodecyl)cyclopentyl]-ethoxy ethanol (8.0 grams, 8.35 m mol), 3,5-di-tert-butyl-4-hydroxybenzoic acid (2.94 grams, 12.6 m mol), and a catalytic amount of p-toluenesulfonic acid in 60 ml toluene were refluxed in a Dean-Stark trap. The reaction was monitored by TLC until all 2-[2-tris(2-octyldodecyl)cyclopentyl]-ethoxy ethanol was consumed. It took 4 days to complete the reaction. The reaction solution was washed with 1M aqueous K_2CO_3 (2 X 20 ml). After being dried, filtered, and rota-vaporized, the crude reaction product was chromatographed on SiO_2, eluting with 3% ethyl acetate/hexane to yield about 9.87 grams of the pure title compound. The pure title compound was characterized by the following: FTIR: 3635 cm^{-1}, 1718 cm^{-1}, 1600 cm^{-1}. ^1H NMR: d 7.92 (s, 2H), d 5.63 (s, 1H), d 4.44 (t, 2H), d 3.74 (t, 2H), d 3.53 (m, 2H), d 1.44 (s, 18H), d 1.22 (br. s.) , d 0.91 (t, 18H). ^{13}C NMR: 167 ppm, 158.2 ppm,135.6 ppm, 127.2 ppm, 121.2 ppm, 68.1 ppm, 64.0 ppm, 45.1 ppm, 34.3 ppm, 31.9 ppm, 30.2 ppm, 30.1 ppm, 29.8 ppm, 29.4 ppm, 22.7 ppm, 14.1 ppm.--

Please replace the paragraph beginning on page 27, line 5 with the following rewritten paragraph:

--Generally, any non-magnetic materials may be used as a substrate support. Suitable materials for the support include, but are not limited to, a metal such as an aluminum alloy, a titanium alloy, or a stainless steel alloy; plastic such as polyester, polyimide, polyamidoimide, polyethersulfone, polysulfone, aromatic polyether, an epoxy resin, a urea resin, a melamine resin, polycarbonate, a diallylphthalate resin, an acrylic resin, a phenolic resin, polyphenylenesulfide, polyphenyleneether, a polyacetal resin, polybutyreneterephthalate, a bismaleimidetriazine resin, a polyoxybenzylene resin, a polyphenylenesulfide; ceramics such as glass, silicon, germanium, alumina, silica, diamond, amorphous carbon, or graphite; and a metal such as an aluminum alloy coated with anodized aluminum, an Ni-P-plating film, Cr, Fe, Ni, stainless steel, Mo or W. It should be recognized that a non-magnetic support is not always necessary in manufacturing a magnetic medium.--

Please replace the paragraph beginning on page 27, line 26 with the following rewritten paragraph:

--Suitable materials for forming the protective layer between the magnetic layer and the